PETROLEUM IN INDIANA.

BY A. C. BENEDICT.

A variety of liquids, variously known as coal oil, crude petroleum, earth oil, maltha, mineral tar, naphtha, steinol, bitumen liquid, etc., and corresponding in the characters of inflammability and insolubility in water with the animal and vegetable oils, have long been known to occur in many parts of the earth.

The countries most famous for the occurrence of mineral oils are the United States, Russia, Burmah and the West Indies. It also occurs in China, India, Italy, Germany, Switzerland, and in limited quantity in France and England.

Chemically, all the various products known as naphtha, petroleum, etc., are closely allied, as they consist mainly of oils of different density and volatility.

The earlier analyses of oils were crude, inasmuch as no further attempt at separating the substances they contained was made than merely heating the oil, cooling the vapors of distillation, and treating the product with sulphuric acid. This sufficed to show that the constituents of petroleum are compounds of hydrogen and carbon. It was not until a comparatively recent date that any advance was made in the chemistry of the hydrocarbons, but now we have a long list of articles of the utmost importance in the arts and sciences derived from the researches of the chemists in this direction.

The earliest analysis of petroleum I have been able to find a record of is that of Winterl, made in 1788, of a black, heavy-bodied petroleum from Hungary; which yielded a colorless oil, a yellow oil, and a buttery mass. The last was probably an impure paraffine. In 1817 the native naphtha of Miano, in the duchy of Parma, Italy, was used for lighting the streets of Genoa. This is probably the earliest use of a city of crude petroleum for lighting purposes. In an account published at that time it is described as being a transparent, thin, yellow liquid, lighter than water, with a strong, persistent smell.

Bitumens are found of all degrees of consistency and of many shades of color. The naphtha of Georgia, on the Caspian Sea, is as colorless as

pure water, while the asphaltum from the Island of Trinidad is a black semi-solid body called the "bitumen lake." The light, clear oils consist almost wholly of carbon and hydrogen, while the heavier, darker and more solid varieties usually contain oxygen, and frequently sulphur and its compounds, carbon and bituminized carbonaceous matter.

The well-known odor of crude petroleum is nearly always due to bituminous matter, spoken of above, or to sulphur compounds, as sulphuretted hydrogen. To the last is due the odor noticeable in the waters of many of the artesian wells of this State.

From the colorless varieties pass by imperceptible gradations through the heavier and darker varieties of petroleum to mineral tar or pitch, that is generally considered petroleum, in which there is enough bituminous matter either dissolved or suspended to render it black and of a semi-fluid consistence. This mineral tar is intermediate between the light-bodied oils and the solid asphaltum.

HISTORY OF PETROLEUM.

The earliest account we have of bitumen is found in the writings of Herodotus describing the building of Babylon. He also describes the method of collecting petroleum in Zante, one of the Ionian Islands, then called Zacynthus. This product he calls "pitch," and says it was obtained by thrusting a pole, having a bunch of myrtle tied to it, to the bottom of the spring and the pitch adhered to it. This spring is still yielding as plentiful as ever, and there can be no reasonable doubt that it has been yielding petroleum for more than 2,000 years. Dr. Paul has stated that five barrels a day may be collected from these wells, and there is little doubt that if proper means were used this quantity might be greatly increased.

Pliny and Dioscorides described the oil from Agrigentum, in Sicily. The latter states it is used in lamps under the name of Sicilian oil, and remarks that this name is erroneous, inasmuch as it is nothing but a species of bitumen. At Clermont and Gabian, in the Province of Languedoc, France, oil springs have been known from time immemorial. Italy also has numerous oil springs. As early as 1817, Genoa was lighted with oil from Amiano, on the Taro, and other places in the North of Italy. This is the earliest recorded use of petroleum as an illuminant I have been able to find.

Plutarch saw a petroleum lake on fire near Ecbatana, in Persia. Baku, on the bank of the Caspian, has long furnished petroleum, and is to-day Russia's main oil field. In consequence of the great number of oil springs, the vast quantity of inflammable gas and the frequent eruption of mud volcanoes, this region is called the Field of Fire.

In North America are vast oil fields, there being scarcely a State or

Territory in the United States in which oil has not been found; but almost the entire supply comes from the States of Pennsylvania, Ohio and West Virginia. In Pennsylvania there have been found ancient wells that are supposed to have been dug and worked by the Mound Builders. In Canada there are two oil regions The most important one is around Enniskillen, to the South of West Canada; the other is on the Peninsula of Gaspe, Canada East. For a distance of four miles along the bank of the Thames, in the Townships of Oxford and Mosa, are some small oil springs. Near Tilsonburgh two well were sunk in 1861, but these sources have never yielded much oil.

The great Pitch Lake of Trinidad is ninety-nine acres in extent. It contains millions of tons of asphalt and is considered the largest and most wonderful deposit of asphalt in the world. It lies at the western shore of the island, nearly midway from its northern to its southern extremity. Asphalt from here is extensively used in paving streets, but the best material for this purpose comes from Neufchatel, Switzerland, where it occurs in limited quantities. On the eastern portion of Trinidad petroleum springs are found between Holguin and Megari, and also in the southwest near Santiago de Cuba.

In France, in 1840, numerous companies were formed for the extraction and purification of oil from the bituminous schists, and in 1845 sixteen mines were in full operation, but the ventures proved unsuccessful, and much capital was sunk.

At Puy de la Pige there are such quantities of mineral tar that it renders the soil so viscous that it adheres to the travelers' feet. In the Harz Mountains, Germany, the same material is found, while at Beehelbronn a similar substance, called stein oil, and sometimes Strasbourg grease, is found. It is too thick to be used as an illuminant, and is used as a substitute for grease to reduce the friction of machinery, and also for greasing the wheels of carriages.

Dalmatia, in the Austrian empire, contains large deposits of limestone so full of bitumen that it can be cut without difficulty.

Gallacia has attracted attention as a source of oils. In West Gallacia the ground is charged with an oil almost identical with the Pennsylvania product. This oil-field, of an extent of 50,000 acres, lies in a mountainous territory, and the wells need only to be bored ten to fifteen feet to reach the oil horizon. According to reports of experts who have visited this region, it will some day become the European oil creek.

Eastern Gallacia yields an oil resembling that of Canada. The wells here are deeper than in West Gallacia. They here extend to the depth of 300 feet, and have to be pumped.

In Crimea the principal Russian sources of oil are found. The oil springs are confined almost wholly to the peninsula of Kertch, where wells sunk a few yards deep yield an oil of fair quality. The position of

the petroleum is indicated by the luxuriant vegetation in early spring, while early in the summer it turns yellow and dries up. This oil-field stretches from the Sea of Azof to the Black Sea, and possibly extends far to the west in the steppes. The rocks here are of Tertiary age, and the oil obtained from them is a deep green in color, thin and transparent. The Tartars sank a large number of wells, and it is found that whenever a well is sunk outside the line of their wells no oil is found, while nearly every one sunk in the vicinity of the ancient wells yields oil.

On the shore of the Caspian Sea there in an immense petroleum area, and Baku has already been mentioned as having long been known as yielding petroleum and natural gas. The oil region here is a tract of country 25 miles long and half a mile in width. Wells are dug here in a porous argillaceous sandstone, of Tertiary age, to a depth of from 16 to 20 feet, and yield a heavy-bodied oil that the natives use in lamps as it comes from the well. These wells were dug by the Russians in 1858, and are still used, for no sooner are they emptied than the oil commences to flow and soon attains its former level.

On the east shore of the Caspian is another field fully equal to the one on the west. The supply seems to be inexhaustible, for a well yielding 500 gallons does not seem to be affected if another is sunk by its side that yields 6,000 gallons.

Sometime since the American method of sinking wells was introduced here, and now the wells are sunk to the depth of 250 feet or more, and the yield of oil thereby greatly increased, the oil frequently spouting to the height of 50 or 75 feet above the surface.

The Persian naptha is of two kinds, black and white. The black is found at Kerkook, and resembles pitch, and is used by the natives along the Euphrates and Tigris for covering the bottoms of their boats, and also for lamp oil.

The main oil regions of Birmah are those near the towns of Teynangyoung and Pagan.

South America furnishes a small amount of solid bitumen or asphalt, but not enough to be of commercial importance.

UNITED STATES.

From the earliest settlement of the country a small quantity of petroleum had been found floating on the surface of a pond on the premises of Watson & Co., Titusville, Pa., and it had long been collected for medicinal purposes by absorbing it in blankets. In 1854 the Pennsylvania Rock Oil Company was formed for the purpose of refining the oil for illuminating purposes and for lubricating machinery, but for several years the operations of the company were not successful. In 1858 Col. Drake,

the Superintendent of the company, conceived the plan of boring wells in the land that had already given so large a surface production of oil. Despite the ridicule heaped on him he continued his operations until 1859, and on the 26th day of August, of that year, found oil at a depth of 71 feet. From this beginning has grown the enormous yield of oil of this country, from which fortunes beyond the dreams of avarice have been accumulated.

The most important oil regions of the United States are in Pennsylvania, New York, Ohio, West Virginia, Kentucky, Indiana, Michigan, Illinois, Tennessee, Wyoming, Colorado, Oregon, Montana and California.

GEOLOGICAL DISTRIBUTION.

The oils in their various forms are found in geological horizons ranging from the Trenton, or lowest, to the Miocene of Tertiary age, but nearly the whole commercial supply of the world, of oils proper, comes from the rocks of Paleozoic age.

THE INDIANA OIL FIELD.

The main field of this State, as developed at this writing, borders the northeast extension of the gas belt, and comprises the northeast part of Grant County, the southeast part of Huntington, the south part of Wells, the north part of Blackford, the southwest part of Adams, the western half of Jay and the western half of Randolph. This is practically one field, having the form of a huge L, extending east from Van Buren, Grant County, to Geneva, Adams County, and south from Geneva to Winchester, Randolph County. A small amount of oil in the gas wells of Tipton, Tipton County, and when wells were drilled at Brightwood, Marion County, some years since, in search for gas, some oil was found, but not in sufficient quantities to pay for pumping. In this field the oil is mainly found in Trenton, but in a few wells a small quantity of oil was found in the Utica shale. At Terre Haute there is a trace of oil in the Sub-Carboniferous limestones at a depth of 850 feet, while at the depth of 1,500 feet oil is found in the Knobstone Group of the Sub-Carboniferous. At Francisville, Pulaski County, oil is found in the gas wells in small quantities and a separator is used to remove it from the gas before the latter enters the mains. In Gillam Township, Jasper County, some wells yielding a heavy lubricating oil have lately been bored, and this is probably the most interesting field yet found, and will be treated of at length in its proper place. These comprise all the localities that have furnished oil in any quantities so far developed in the State. Traces of oil were found in drilling the gas wells of Washington, Harrison and Crawford Counties,

CRAWFORD COUNTY, IND.

In the western part of Crawford County there are surface indications of oil that have an extent of five miles in width by ten miles in length, and consist of tar springs on land formerly owned by L. D. Parker, of Union Township; oil springs and oil rock in great abundance. The tar springs are nine miles northwest of Leavenworth, and have been known from the earliest settlement of the country. These springs are about half way up a hill which is probably one hundred and fifty feet high. They are "wet-weather" springs, delivering a large volume of water after heavy rains, but dwindling to a mere trickle of water in dry weather. In the course of a year a large amount of tar or asphaltum is deposited by these springs. This asphaltum unites with the soil and sand, and has built up quite a trough around the spring.

Oil springs are found on Otter Fork and West Fork, and in the hollows tributary to them; there are quite a number of them from which small quantities of oil can be collected. The oil rock is found in great abundance. At one place on Otter Fork the bed of the creek is a soft black sandstone, or shale, which contains more than thirty per cent. of oil. If a piece of it be placed on a hot fire it will blaze like a candle, and will continue to burn until it has lost one-third its weight. During the oil excitement of 1862–66 oil seekers flocked here, and the excitement ran high, owing to the promising surface indications. Several wells were sunk, but oil in paying quantities was never found.

On the farm of Mr. J. J. Clark a well was bored during the oil craze of 1862–66, but only a very small quantity of petroleum mixed with salt water was found.

SECTION OF THE CLARK WELL.

Kaskaskia limestone	6 feet.
Red shale	7 feet.
Blue Kaskaskia limestone	20 feet.
Shale and chert	11 feet.
Limestone	6 feet.
Shale	8 feet.
St. Louis limestone	350 feet.
Knobstone Group	240 feet.
Total depth	648 feet.

At 408 feet natural gas was found, and at 648 feet salt water and a small amount of petroleum.

MIFFLIN WELL, DRILLED 1865.

Drift	15 feet.
Kaskaskia limestone and sandstone	190 feet.
St. Louis limestone	310 feet.
Keokuk limestone and sandstone	80 feet.
Knobstone Group	490 feet.
Genesee shale	110 feet.
Total depth	1,180 feet.

At a depth of 135 feet a small quantity of petroleum was found, while at 1,180 feet natural gas in considerable quantities was found, and also a small amount of petroleum. In settled weather the combined weight of the atmosphere and the column of water in the well is sufficient to overcome the pressure of the gas, while just preceding a storm, when the weight of the air is reduced, the gas rises with sufficient force to throw jets of water several feet above the mouth of the well.

SECTION OF TERRE HAUTE WELL.

	Feet.	Inches.
Drift	150	
Fire clay and Shale	14	6
Coal L.	4	
Limestone	2	1
Fire-clay	3	2
Brown Limestone	2	
Shale	1	6
Coal K.		6
Fire-clay	3	2
Limestone	16	5
Shale	4	
Coal I.	2	
Fire-clay	3	
Limestone	6	
Sandstone	3	
Fire-clay	5	
Shale	4	6
Limestone	5	2
Shale	9	
Blue Sandstone	6	
Shale	2	
Fire-clay	5	
Sandstone	10	
Coal G.		9
Fire-clay	2	5
Limestone	3	4
Shale and Fire-clay	5	3
Limestone	4	
Fire-clay	5	10
Limestone	3	6
Coal F.	2	6
Fire-clay	1	
Sandstone	28	3
Fire-clay	7	2
Blue Sandstone	27	
Shale	9	
Sandstone	37	
Shale	36	3
Sandstone	1	8
Shale	26	
Sandstone	36	
Shale	79	
Sandstone	23	10
Black Limestone	9	6
Shale	12	
Sandstone, Millstone Grit	127	
Limestones, Sandstones and Shales	922	10

From the data at hand it is not possible to separate this into horizons, but it is thought that this reaches through the following formations in descending order: Kaskaskia, St. Louis, Keokuk, Knobstone, and possibly into the Devonian.

Prof. Gorby reports* that at 840 feet a show of oil was found; at a depth of 1,296 feet 9 inches a lubricating oil was found, and at a depth of 1,620 feet 10 inches a vein of oil was found. Between the second and third oils a flow of fresh water was found, while below the third vein of oil four strong flows of sulphur water were successively encountered in drilling the well. The oil found at a depth of 840 feet is probably in rocks of the age of the Kaskaskia, and, so far as the writer's knowledge extends, is the highest in the geological series that oil has been found in this State. That found respectively at 1,296 feet 9 inches and 1,620 feet 10 inches is no doubt in rocks of the age of the Knobstone Group, but the oil has probably come from the slow distillation of the carbonaceous Genesee shale underlying these sandstones. The Genesee shale extends in a north-south direction nearly across the State, and contains so much carbonaceous matter that it is frequently mistaken by the uninformed for coal, the more readily so by reason of its burning when placed on a hot fire. At Terre Haute this shale is deeply buried, and a slow distillation has been carried on for countless ages by the chemical forces of nature and has resulted in the oil found here. There is enough oil in this shale, were it distilled, to furnish a large number of "gushers," and it may be that some one will be so fortunate as to find the field where it is located. Certain it is that these Terre Haute wells, isolated as they are, are rather unique, and offer an inviting field for speculation concerning why some of the wells here should yield oil so abundantly and others adjoining them should be dry holes.

The section given above is fairly illustrative of the rocks underlying this region, and it now remains to give the yield of oil for the three yielding wells of the Guarantee Oil and Gas Company:

There were 54,750 barrels of oil pumped from these wells, and it was used for fuel and for gas making, the gas being used both for lighting and heating purposes, and answers admirably for both, and is extensively used because it is sold so cheaply, costing less than half the price charged consumers in many other cities of the same size. While this gas can not be furnished as cheaply as natural gas, and probably does not possess as great heating power, yet it furnishes the best and cheapest substitute for this wonderful fuel and illuminant that is at present available. For heating purposes it is certainly economy, if suitable burners be used, to use the crude oil instead of first converting it into gas, but care must be used in storing, piping and using the oil, or disastrous results will follow. No

*Sixteenth Report of the State Geologist, page 262.

analysis of this oil is at hand, though I made effort to procure it for publication, believing it would be of general interest. I am, therefore, unable to indicate the value of this oil and the uses to which it may be put.

FRANCISVILLE.

At Francisville, Pulaski County, the Francisville Natural Gas, Oil and Coal Company put down a well October, 1887, which showed the following section:

Drift	8 feet.
Niagara limestone	542 feet.
Hudson River limestone and shale	235 feet.
Utica shale	100 feet.
Trenton	10 feet.

At seventy-four feet in the Hudson River Group oil was found, and the yield was estimated at twenty-five barrels per day. It was a moderately heavy bodied lubricating oil, and answered satisfactorily the tests to which it was subjected.

At the junction of the Utica shale and Trenton another flow of oil was found, of an estimated flow of ten barrels per day. A small quantity of gas was found in this well, and the company being more desirous of securing gas than oil, had a charge of nitro-glycerine exploded in the well with the result of ruining it for both oil and gas. If the flow of oil be as great as estimated, the territory in the vicinity of this well, and to the west of it, invites further tests of the drill, with a reasonable prospect that paying yields of oil will be found.

In May, 1888, the Union Oil and Gas Company commenced operations and sunk five wells, one of them having a small showing of oil at the depth of 625 feet, and three of the remainder furnishing gas at 895 to 900 feet. The rock passed through did not differ materially from that found in the well of the Francisville Natural Gas, Oil and Coal Company, a section of which is given above. The Trenton Rock Company put down two wells here and found a trace of oil at 625 feet, but no gas. I was unable to get a section of the rock passed through in drilling these wells, but suppose it is similar or identical with the section given above. In 1865 a well was drilled southwest of town, and a considerable flow of gas was found, and also water, but at that time the uses of gas were not known, and the well was abandoned and continued to flow water and gas until 1888, when it was plugged. There is no record that oil was found here, and the above is given as relating to the probable life of a gas well if it is not overworked. The water here spoken of came in above the gas and thus retarded its flow and prevented the well from being overworked and drawing salt water. The gas wells put down in 1888 furnished an

abundance of gas, and thus demonstrated that the field was not seriously weakened, although the area of gas-bearing rock here, so far as developed, is small as compared with the main gas-field.

MEDARYSVILLE.

E. W. Gillette has drilled three producing wells seven miles west of this town, and the following section is shown by the drillings:

Drift	40 feet.
Black shale	50 feet.
Limestone	6 feet.
Oil sand	2½ to 3 feet.

The estimated yield of two of these wells is twenty-five barrels per day of an oil almost as thick as coal tar, and of excellent lubricating qualities. All that is necessary to render it fit for use is to heat it for a sufficient length of time to allow the sand and other impurities to settle, and then draw off the clear oil ready for use. The farmers have been using this as a lubricant on their wagons, and find it an excellent substitute for tar, so heavy-bodied is it.

The oil sand here is geologically known as the Scoharie Grit, one of the subordinate divisions of the Upper Helderberg Group of the Devonian. The oil, as in the Terre Haute wells, doubtless is derived from the Genesee Shale that is given in the section of the well as black shale. This is further evidenced by an extensive deposit of asphaltum a few miles south of the wells, and could have come from no other known source than the shale. If this field proves extensive, which at present seems doubtful, it will be very remunerative to well owners, as an oil of this quality is worth about half as much per gallon as the ordinary crude oil is per barrel, while the cost of drilling and pumping is much less than for the comparatively deep wells of the other parts of the field.

On the farm of A. W. Williams, six miles west of Medarysville, a well was drilled that showed the following section:

Drift	50 feet.
Black shale	30 feet.
Limestone	500 feet.
Sandstone (?)	10 feet.
Hudson River	250 feet.
Utica shale	130 feet.
Trenton	60 feet.
Total	1,030 feet.

At the top of Trenton a small amount of oil was found, and salt water in the rock the remainder of the depth. The ten feet of so-called sandstone in this well is probably a hard ferruginous limestone at the base of

the Niagara that has been referred to the Clinton epoch. Stone of this character outcrops in the neighborhood of Madison, west of Laurel in Franklin County, and south of Longwood, Fayette County. If this proves to be the same as the outcrops in the eastern part of the State, it is of interest as showing the western extension of these outcrops. The oil sand is here wanting, and the section indicates that it has thinned out and disappeared in coming east one mile from the wells. This indicates the dip of the underlying Niagara limestone to be to the west, and further search for oil should be in this direction rather than to the east or south.

ROYAL CENTER.

At the present time operations are suspended here. A company was organized in 1891, with S. P. Sherin, of Logansport, President, but owing to unforeseen difficulties nothing was done last season toward developing this field, but hope to drill several wells soon. The intention of the company is to thoroughly test the territory in hopes of finding an abundance of oil.

SECTION OF OIL WELL AT ROYAL CENTER.

Drift	105 feet.
Niagara limestone	485 feet.
Hudson River	220 feet.
Brown shale, Utica shale	110 feet.
Trenton	42 feet.
Total depth	962 feet.

Oil was found in Trenton and also a small flow of gas. The estimated yield of oil, if the well was pumped, is twenty-five barrels per day of an excellent lubricating oil. Mr. Layne, owner of the flour mill here, informed me that his miller uses this oil on all the machinery of the mill in preference to any he could get in the market. A practical test, such as this, is worth more to the user than a whole volume of analyses beclouded with technical terms and symbols that it is possible the analyst does not always understand.

In the above test the oil was subjected to a variety of conditions, from the greatest to the least friction, from the slowest to the fastest moving machinery, and gave complete satisfaction everywhere. When an article does this it can safely be stamped *good*.

FORT WAYNE.

During the excitement attending the discovery of natural gas in the State Ft. Wayne caught the fever and sank some wells, in one of which oil was found, but not in paying quantities.

The following is a section of the well copied from the 16th Geological Report of Indiana.

Drift	77 feet.
Water-lime	30 feet.
Niagara	570 feet.
Hudson River and Utica	751 feet.
Trenton	15 feet.

At 1,431 feet oil was found. This would place the oil stratum in the top of the Trenton, and it is possible that when oil is found at top of Trenton the source of supply is carbonaceous Utica shale.

CICERO.

The following section is also copied from the 16th Indiana Report:

Drift	161 feet.
Niagara limestone and shale	300 feet.
Hudson River and Utica	490 feet.
Trenton limestone	32 feet.
Total depth	983 feet.

At $974\frac{5}{10}$ feet a considerable flow of oil was found, the yield being estimated from five to twenty barrels per day. The oil here was found twenty-three and one-half feet in Trenton. A medium flow of gas was found at 966 feet.

MARION.

Some of the wells in the vicinity of Marion, mainly to the east from there, show traces of oil, while some of them yield several barrels per day. When the Stove Foundry well, south of the Canton Glass Works, was drilled it showed traces of oil, but not enough oil was found to interfere with the working of the well. The Jas. Lugar well, five miles east of town, furnished a small quantity of oil, probably two barrels per day, mixed with gas, from which it is removed by a separator. I was unable to get a record of the strata passed through in drilling this well, and therefore give one from the 16th Indiana Report, of a well located in Marion; one furnished by Mr. Sweetser, of a well drilled one mile northeast of town, and a section of a well at Van Buren, furnished by Dr. Lew Corey, of Van Buren.

SECTION OF WELL No. 3, AT MARION.

Drift	70 feet.
Niagara limestone	280 feet.
Hudson River and Utica	528 feet.
Trenton limestone	22 feet.
Total	900 feet.

This well yielded a strong flow of gas, but no oil.

SECTION OF WELL ONE MILE NORTHEAST OF TOWN.

Drift	157 feet.
Niagara limestone	260 feet.
Hudson River and Utica	317 feet.
Trenton limestone	28 feet.
Total	762 feet.

Here, as above, a strong flow of gas was obtained, but no oil.

If both these records are correct they show a remarkable variation in the thickness of the strata within a small area, the Niagara limestone, the Trenton and Utica in the second section, having lost 231 feet in thickness, while the Drift has gained 87 feet; while Trenton is reached in the first section given at 878 feet, in the second at 744 feet, a rise of 134 feet.

In another well, one and one-half miles southeast of Marion, the Niagara, the Hudson River and Utica had still further thinned out, while the Drift increased in thickness.

SECTION OF WELL ONE AND ONE-HALF MILES SOUTHEAST OF MARION.

Drift	194 feet.
Niagara limestone	233 feet.
Hudson River and Utica	314 feet.
In Trenton	28 feet.

VAN BUREN.

There are three wells in Van Buren Township, one being located in the eastern part of the town of Van Buren, and the remaining two in the southern part of the township. The one in town was never fairly tested as an oil well, but was estimated by the driller to yield 25 barrels per day. It being owned by a non-resident is not pumped, although it would pay to do so if the yield of oil is as great as estimated.

The two wells in the southern part of the township yield gas, and the oil is removed by separators. The yield of oil of these wells was estimated by Dr. Lew Corey at 25 barrels per day, but this estimate is probably too high. No wells have been drilled for oil exclusively in this territory, and it may be regarded at once as promising and undeveloped, and will, do doubt, richly repay the driller when he comes to exploit this field.

WARREN.

In the southeast corner of Jefferson Township, about two miles southwest of Warren, a well was drilled that yielded oil, the estimated flow of which was 25 barrels per day. The drillers were seeking gas and not oil, and therefore the well is not worked. The same remarks used regarding the Van Buren field apply with equal force to this region.

Another well in Warren yields a trace of oil, while one three miles east of town yielded a small amount of oil and salt water in abundance. This indicates, as far as the data goes, that the field west of Warren and north of Van Buren is the better territory. The following section, given from memory by Dr. Good, Sr., is all that I was able to obtain of the wells here. It is to be regretted that accurate and minute records are not kept of each well drilled, for those records are of great value, as they enable the geologist to work out the geology of a region with great minuteness:

SECTION OF WELL SOUTHWEST OF WARREN.

Drift	140 feet.
Niagara limestone	310 feet.
Hudson River and Utica	550 feet.
In Trenton, oil in Trenton	27 feet.

This shows a thickening of the Niagara limestone, the Hudson River and Utica eastward from Marion.

WELLS COUNTY.

The Northern Indiana Oil Company, of Bluffton, has fifteen wells in the neighborhood of Nottingham, in the southeastern part of the county, which are in what is called the Montpelier field, lying east of that place, west of Geneva and northwest of Bryant. This is the main oil field as worked at present. If Montpelier were taken as the base and a semi-circle described with a radius of fifteen miles extending from Union Grove on the west to Portland on the east, it will enclose all the worked territory in the eastern part of the State. This embraces parts of Grant, Huntington, Wells, Adams and Jay Counties.

There has been no record kept by the Northern Indiana Oil Company of the wells near Nottingham, the section given below being from memory by the driller, but it is doubtless approximately correct.

Drift	80 feet.
Niagara limestone	200 feet.
Hudson River	500 feet.
Utica shale	200 feet.
In Trenton	20 feet.

The drillers say there is no material difference in the depth at which Trenton is found, ten feet marking the extreme limit of variation of depth.

The wells yield an average of twenty barrels each per day. Some of the wells yield a much greater amount than this, while others fall below it. The highest reported yield is 300 barrels per day.

At each well there are storage tanks, generally two, of 250 barrels capacity, and when these are full the oil is measured by a gauger employed

by the company buying the oil, and is then transferred to a pipe line and conveyed to the tank cars. The Standard Oil Company and the Manhattan Oil Company are the largest, if not the only, purchasers here. These companies are reported as paying from 35 to 40 cents per barrel of 42 gallons for the oil from the tanks.

MONTPELIER.

Manhattan Oil Company.

This company has ten producing and two dry wells in Jackson Township, Wells County. These wells average twenty barrels per day. One of the wells yields one hundred barrels per day, and has been yielding at this rate for two months. All the wells of this company, except one, have to be pumped.

Well No. 1, the McIntire well, was drilled September, 1890. It came in as a twenty-barrel well, and the yield has been constantly increasing. No. 2 furnishes the same amount, while No. 3 is the one yielding one hundred barrels per day. This company ships its oil to Lima, Ohio, where it has refineries. Storage tanks from 250 to 800 barrels capacity are used, the largest tanks, of course, being used at the best wells. The production of this company is estimated to be 60,000 barrels per annum, which they expect to double next season by drilling new wells.

The Jackson Oil Company.

This company commenced operations October 3, 1890, and has drilled twenty-eight wells, five of which are dry.

The following section of a well in Chester Township, Wells County, may be taken as fairly illustrative of that portion of the field lying adjacent to Keystone; premising it by the statement that this township is the northern limit of the field as developed.

KEYSTONE WELL.

Drift	62 feet.
Niagara limestone	260 feet.
Hudson River	375 feet.
Utica shale	300 feet.
Trenton	30 feet.

Occasionally two strata of oil-bearing rock are found in Trenton, but where these are found the yield of oil is rarely increased, the oil-bearing strata being, in nearly every case, either thinner or denser, so the production remains about the same. This double stratum seems to be only local, and to have been governed by the same laws that caused a division

of the coal seams, in the Coal Measures. Here, as there, we have multiplication of product yielding horizons without notable increase of product, as, at first thought, would seem to follow.

WELL IN JACKSON TOWNSHIP.

Drift	243 feet.
Niagara limestone	117 feet.
Hudson River	375 feet.
Utica shale	300 feet.
Trenton	25 feet.

In this well but a single oil-bearing stratum was found, yielding at the rate of thirty barrels per day of 24 hours.

The reported average yield of these wells is six barrels per day, the best yielding 51 barrels, the next best two 50 barrels each, in 24 hours.

As is the custom, one to two tanks are used at each well of a capacity varying from 250 to 600 barrels. The Buckeye Pipe Line purchase this oil.

Six miles northeast of Montpelier the water is cased out at a depth of 200 feet. Six miles west of town the last flow is found at 370 feet, indicating a dip of the strata to the southwest of 14 feet to the mile.

There are a number of wells, seven in all, owned by various parties at this writing, but the number is being rapidly increased, and by the end of the season of 1892 the total number of wells in this territory will no doubt be doubled. There was shipped from Montpelier during the month of January, 1892, 10,960 barrels of oil, indicating an annual production of 131,520 barrels of forty-two gallons each. The value of this oil at the well is about $50,000. This is a neat little sum, but small in comparison with the amount to be secured in the future when the "gushers," that are so ardently hoped for by both drillers and land owners, are struck.

PORTLAND.

There have been but few wells drilled here, probably four marks the limit. They were put down for gas, and on failure to find it, wells were drilled in the vicinity of Camden and the gas piped to town. On the failure to find gas about Portland, the field was abandoned and the wells not pumped for oil.

SECTION OF WELL THREE MILES WEST OF PORTLAND, ON FARM OF JOHN GILBERT.

Drift	42 feet.
Niagara limestone	225 feet.
Hudson River	435 feet.
Utica shale	300 feet.
Trenton	25 feet.

Oil reached at ten feet in Trenton, flowing 45 barrels of heavy lubricating oil per day.

The well on A. H. Croninger's farm showed the same section as the above, and flowed twenty barrels per day, but, owing to lack of market, all these wells are closed. There was not enough oil produced by these wells to justify a pipe line, and, for some reason, no other wells were put down, so the field is abandoned at present. The yield shows this to be a very promising field, and the wells being flowing ones, the expense of pumping is saved. This alone is an important item of expense in the production of oil.

The Jas. Penn well, near the above-mentioned ones, yielded fifteen barrels per day, but it did not flow, the oil being pumped.

WINCHESTER.

The Rock Oil Company control twenty-one wells here, nine of which have had the pipe drawn from them and are abandoned. The first well was drilled here September 28, 1886, and the last one September 16, 1891. A number of the wells now owned by this company were drilled by other parties and sold to the Rock Oil Company, and it is now using them as gas wells, as no well owned by this company yields enough oil to pay for pumping, though each one, except No. 4, yields a small quantity of dark, heavy oil that is removed from the gas by separators and blown out, generally once a week, by the well man. The exception, No. 4, yields a small amount of amber-colored, heavy-bodied oil.

Well No 1 is located near the Court House; No. 4, one and one-fourth miles west of town; No. 5, one and one-half miles northwest; all the others are within a few miles of town in a western direction.

SECTIONS OF WELLS FROM RECORD KEPT BY DR. J. C. HIRSH.

Well No. 4, *on Farm of Silas Colgrove. Drilled May* 9, 1886.

Drift	334 feet.
Hudson River and Utica	718 feet.
In Trenton	120 feet.
Total	1,172 feet.

This record does not show the depth at which gas and oil were found.

Well No. 5, *Jas. Cranor's Farm. Drilled January* 11, 1888.

Drift	331 feet.
Hudson River and Utica	740 feet.
In Trenton	75 feet.
Total	1,146 feet.

No record of the horizon or the yield of oil and gas by this well. Well abandoned and pipe and casing drawn.

Well No. 6, *James Pierce's Farm. Drilled March* 16, 1888.

Drift	136 feet.
Niagara limestone	65 feet.
Hudson River	543 feet.
Utica shale	300 feet.
In Trenton	27½ feet.
Total depth	1,071½ feet.

Gas and oil were found from 1,056 to 1,060 feet, but the quantity of oil was small, probably not exceeding one barrel in twenty-four hours.

Well No. 7, *Eliza Goodrich's Farm. Drilled May* 2, 1888.

Drift	102 feet.
Niagara limestone	85 feet.
Hudson River	549 feet.
Utica shale	300 feet.
In Trenton	49 feet.
Total depth	1,085 feet.

Gas and oil from 1,061 to 1,071 in depth, or from 25 to 35 feet in Trenton.

Well No. 8, *Eliza Goodrich's Farm. Drilled July* 12, 1888.

Drift	70 feet.
Niagara limestone	110 feet.
Hudson River	520 feet.
Utica shale	332½ feet.
In Trenton	51½ feet.
Total depth	1,084 feet.

Gas and oil were found at a depth of 1,052 feet. Only a small quantity of oil was found. This well is now abandoned.

Well No. 9, *James Pierce's Farm. Drilled September* 7, 1888.

Drift	128 feet.
Niagara limestone	82 feet.
Hudson River	520 feet.
Utica shale	306 feet.
In Trenton	44 feet.
Total depth	1,080 feet.

Oil and gas at a depth of 1,067 feet. Small flow of oil and good flow of gas.

Well No. 10, *James Pierce's Farm. Drilled October* 16, 1888.

Drift	117½ feet.
Niagara limestone	85 feet.
Hudson River	520 feet.
Utica shale	314½ feet.
In Trenton	43 feet.
Total depth	1,080 feet.

Oil and gas from a depth of 1,057 to 1,069 feet.

No. 11, Beech Grove Well.

Drift	90 feet.
Niagara limestone	100 feet.
Hudson River	543 feet.
Utica shale	320 feet.
In Trenton	42 feet.
Total depth	1,095 feet.

Gas and oil at 1,075 feet.

Wild Cat Well, Drilled September 10, 1889.

Drift	97 feet.
Niagara limestone	120 feet.
Hudson River	540 feet.
Utica shale	313 feet.
In Trenton	50 feet.
Total depth	1,120 feet.

Gas and oil at 1,100, 1,104 and 1,107 feet.

John Summer's Well, Drilled September, 1889.

Drift	170 feet.
Niagara limestone	55 feet.
Hudson River	537 feet.
Utica shale	330 feet.
In Trenton	53 feet.
Total depth	1,145 feet.

This well is now abandoned, and the record does not show at what depth oil and gas were found, or if they were found at all.

The Sim-Scott Well. Drilled October, 1889.

Drift	121 feet.
Niagara limestone	99 feet.
Hudson River	530 feet.
Utica shale	225 feet.
In Trenton	50 feet.
Total depth	1,125 feet.

This well is now abandoned, but at the time of drilling gas and oil were found at a depth of 1,098 feet.

The Price Well. Drilled November, 1889.

Drift	83 feet.
Niagara limestone	149 feet.
Hudson River	530 feet.
Utica shale	308 feet.
In Trenton	32 feet.
Total depth	1,102 feet.

Oil and gas from 1,085 to 1,095 feet.

Well No. 13, *on Mrs. Leitchert's Farm. Drilled November* 26, 1889.

Drift	94 feet.
Niagara limestone	110 feet.
Hudson River	530 feet.
Utica shale	316 feet.
In Trenton	50 feet.
Total depth	1,100 feet.

At a depth of 1,075 feet a small flow of gas was found, and a trace of oil, but the well is now abandoned.

No. 14, *Wm. Coates' Well. Drilled May* 17, 1890.

Drift	88 feet.
Niagara limestone	142 feet.
Hudson River	541 feet.
Utica shale	300 feet.
In Trenton	53 feet.
Total depth	1,124 feet.

Gas and oil at 1,094 feet. Well now abandoned.

Well No. 15, *on Farm of David Hippenheimer. Drilled June* 20, 1890.

Drift	118 feet.
Niagara limestone	110 feet.
Hudson River	525 feet.
Utica shale	323 feet.
In Trenton	36 feet.
Total depth	1,112 feet.

Gas found at 32 feet in Trenton. A small quantity of oil is mixed with the gas, but is easily removed by the use of a separator, and is blown off once each week.

Well No. 16, *on Farm of Jacob Hippenhiemer. Drilled July* 28, 1890.

Drift	98 feet.
Niagara limestone	110 feet.
Hudson River	542 feet.
Utica shale	330 feet.
In Trenton	75 feet.
Total depth	1,155 feet.

Gas at 32 feet in Trenton.

Well No. 17, *on Farm of David Hippenheimer. Drilled July* 31, 1891.

Drift	150 feet.
Niagara limestone	85 feet.
Hudson River	525 feet.
Utica shale	327 feet.
In Trenton	48 feet.
Total depth	1,135 feet.

Well abandoned. A small flow of gas and oil at 1,104 feet, or 17 feet in Trenton.